

THE WEATHER AND CIRCULATION OF AUGUST 1970

Typical Summer Heat Associated With a Flat, Persistent Upper Level Flow

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1. WEATHER SUMMARY

Severe hurricane Celia struck Corpus Christi, Tex., on August 3. The extreme winds caused the loss of eight lives in northwestern Florida from dangerous surf and 11 lives and property damage of about \$450 million in Texas according to a preliminary report (Orton 1970). Water damage by inundation and flooding appeared to have been relatively unimportant.

The upper level mean circulation this month differed slightly from normal and contributed little to new monthly weather records. This was the hottest August of record at Port Arthur, Tex. (85.5°F), and Pueblo, Colo. (79.9°F). Many daily temperature records were established, especially daily maxima, from the Plains States (108°F at Goodland, Kans.) to the west coast (105°F at Medford, Oreg.). The only monthly minimum of note was at Duluth, Minn., where 33°F was recorded on August 31.

Heavy precipitation fell in several areas, some associated with tropical disturbances. Principal monthly totals and departures from normal were: Appalachicola, Fla., 21.08 in., 13.34 in. above normal, a new August record; Hilo, Hawaii, 10.53 in., 9.08 in. above normal; and Wilmington, N.C., 13.98 in., 7.12 in. above normal. Very little precipitation fell in central and northern portions of the Plains States and Rockies and in the Pacific Coast States. This created new records at Glasgow, Mont. (0.04 in.) and at Bismarck, N. Dak. (0.13 in.).

2. MONTHLY MEAN CIRCULATION

Mean 700-mb flow in August (figs. 1 and 2) averaged near normal (7.2 m sec⁻¹) in middle latitudes in the western portion of the Northern Hemisphere. Wind speeds were higher than normal in the Pacific; but over North America and the Atlantic, subnormal speeds prevailed.

The trough along the east coast of North America in July deepened by about 40 m in August near Nova Scotia, while heights increased by 50 m near Baffin Strait (fig. 3). This was the westernmost reflection of blocking that extended from Novaya Zemlya to the United Kingdom and westward to North America. Blocking was strongest over Scandinavia where 700-mb heights averaged 60 m above normal. This represented the largest 700-mb height change from July in the Northern Hemisphere. Between Scotland and Norway, heights increased by 130 m as the deep Low of July was replaced by strong ridging, especially near Scandinavia. Meanwhile, deepening occurred in the eastern Atlantic as the westerlies split into two branches, one moving to 75° N. near Spitzbergen and the other toward Spain (fig. 4).

Rather flat westerly flow with mean 700-mb heights near or slightly above normal characterized most of Asia except in the most northerly latitudes. In this area, the strongest cyclonic center of action in the Northern Hemisphere formed in August. In the Siberian Sea, heights decreased by as much as 100 m as a Low replaced the ridge of July. From Lake Baikal to the Kamchatka Peninsula, the maximum average wind speed was 10°–15° latitude farther north than normal. Thickness from 1000 to 700 mb in Asia (not shown) averaged below normal north of 60° N., but ranged to 60 m and more above normal from the Pacific coastline of Asia to the Caspian Sea, suggesting very warm conditions in middle latitudes.

Over middle latitudes of the North Pacific, the flow remained anticyclonic this month with a maximum positive height anomaly of 70 m near 40° N. Cyclonic flow continued to dominate above 50° N. with heights below normal from the Gulf of Alaska northwestward. The strong flow responsible for these anomalies resulted in maximum westerly winds of more than 15 m sec⁻¹ (fig. 4), about 5 m sec⁻¹ higher than normal. July to August height changes over most of the Pacific were slight this month except in the Aleutians. Here, heights increased by 60–80 m, but this had little apparent effect downstream as the trough in the eastern Pacific maintained about the same strength it had in July.

Over and near North America, the simple pattern of a weak ridge in the West and a weak trough in the East persisted. Maximum height departures from normal were generally less than 2 or 3 m. The 700-mb jet was displaced about 5° latitude north of normal to near 55° N.

3. MONTHLY WEATHER

High persistence at 700 mb over the Nation resulted in high persistence of the surface temperature from July to August. Of 100 representative cities, the temperature anomaly of 80 cities changed by no more than one class. Of the remainder, most showed the temperature two classes warmer than in July (i.e., from below normal to above normal) in the lower Mississippi Valley and in central portions of the Great Plains and Rocky Mountain States.

Monthly temperature anomalies for August (fig. 5) averaged 1° to 2°F below normal in portions of the area from the central Appalachians to the Mississippi Valley. Weak 700-mb flow here (figs. 1 and 2) produced negative height anomalies and negative height changes of only a

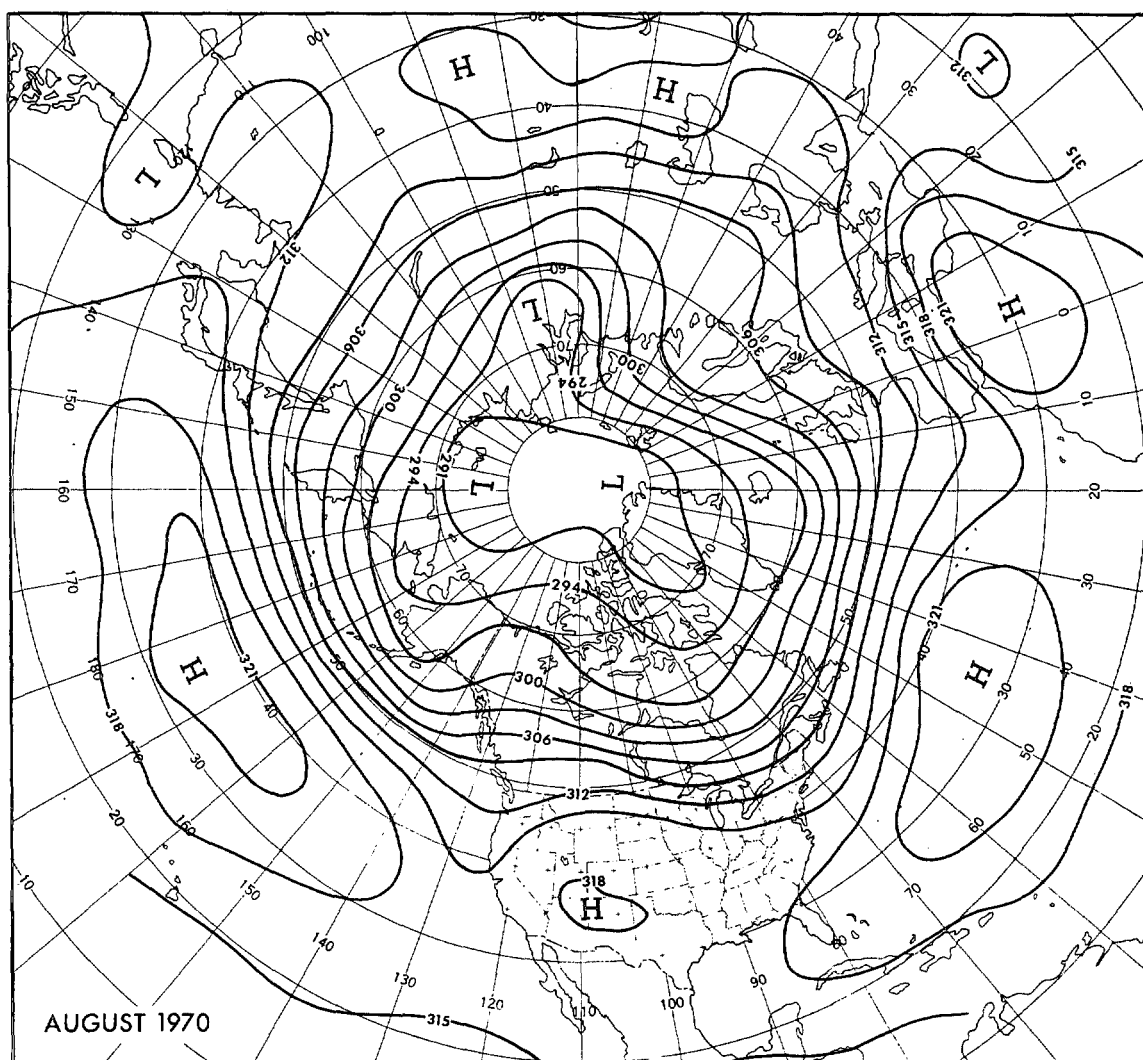


FIGURE 1.—Mean 700-mb contours (decameters) for August 1970.

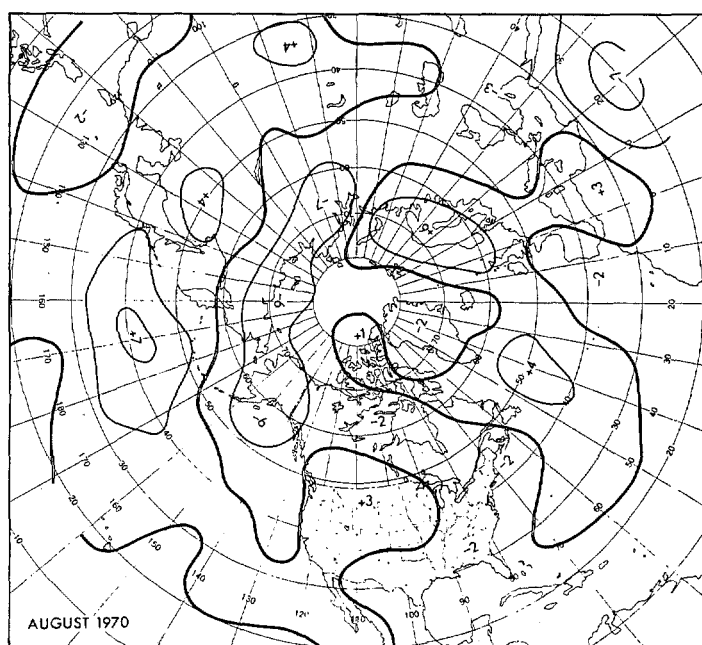


FIGURE 2.—Departure from normal of mean 700-mb height (decameters) for August 1970.

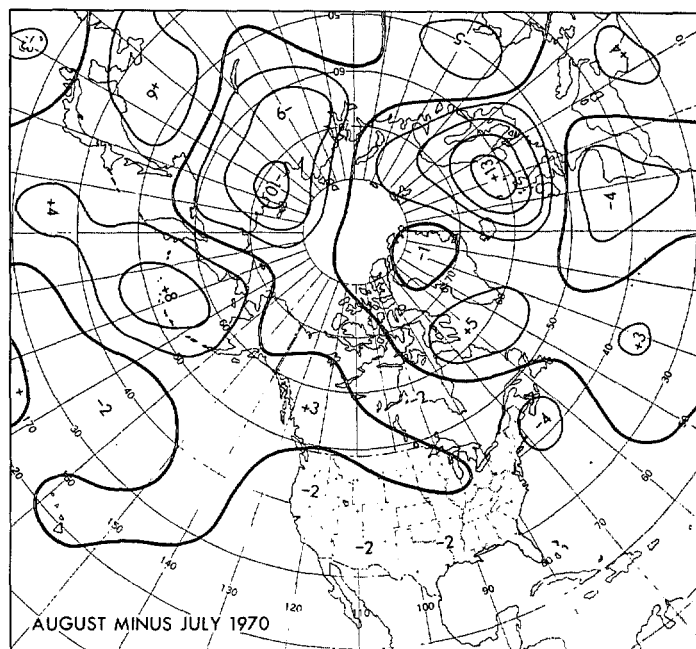


FIGURE 3.—Mean 700-mb height change (decameters) from July to August 1970.

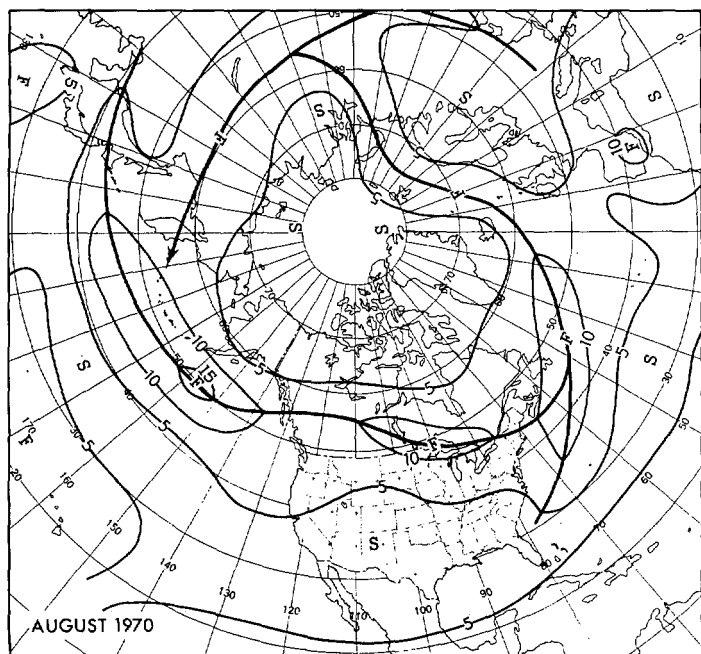


FIGURE 4.—Mean 700-mb isotachs (meters per second) for August 1970. Heavy lines show principal axes of maximum wind speed.

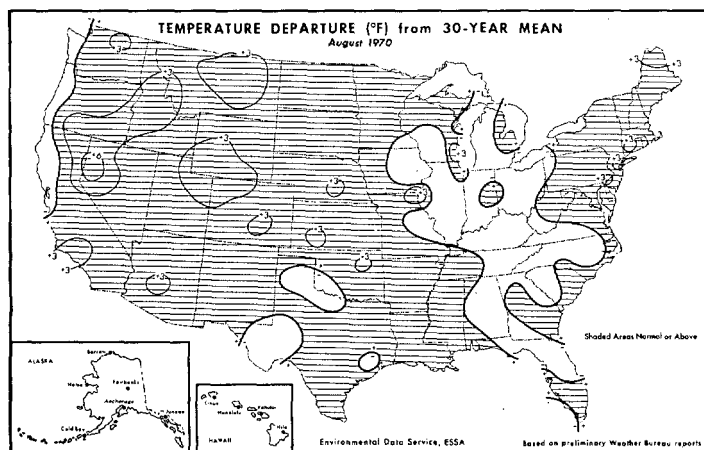


FIGURE 5.—Departure from normal of average surface temperature (°F) for August 1970 (from Environmental Science Services Administration and Statistical Reporting Service 1970).

few meters. Temperature anomalies also changed slightly from July to August.

The largest temperature anomaly this month (3°–6°F) occurred in parts of the Great Basin, a continuation of above-normal temperatures since early summer. Accompanying this heating in the interior of the West were below-normal temperatures along the west coast from northern California to Washington. This temperature regime was intensified by stronger than normal northerly sea-level flow, conducive to upwelling and lower than normal sea-surface temperatures.

Precipitation this August (fig. 6) was typical of a summer month with patches of rainfall in many areas. In the southern plateau, more than twice normal rain fell. On the 11th, Yuma, Ariz., had its first precipitation in 158 days; and on the 26th, the heaviest 24-hr total since

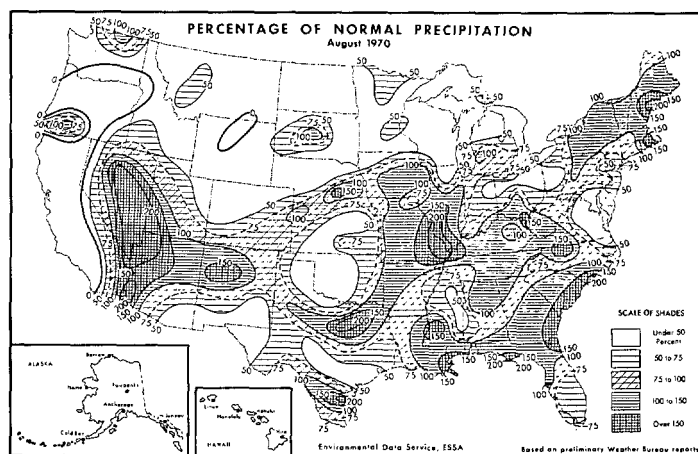


FIGURE 6.—Percentage of normal precipitation for August 1970 (from Environmental Science Services Administration and Statistical Reporting Service 1970).

1943. Most of the rainfall in the central Mississippi Valley and along the gulf coast came from slow-moving fronts, only two of which reached the Gulf Coast States this month. Normal and greater precipitation in the Northeast was related to the 700-mb trough that was slightly deeper than normal.

Unusual dryness accompanied above-normal temperatures and strongly anticyclonic curvature or northwesterly flow. These conditions extended from the northern Great Lakes to the Pacific Northwest and southward to the central Rockies and central plains.

4. WEEKLY WEATHER

FIRST WEEK

Mean 700-mb flow, representative of the week (fig. 7A), showed a Low in the eastern Gulf of Alaska and a trough southward off the west coast of North America. A ridge covered most of western North America, and a trough extended from a Low near Baffin Island through the Northeast and southward to the subtropics. This large-amplitude flow was quite weak with heights only 60 m above normal in the ridge near Lake Winnipeg and 70 m below normal in the Low.

Surface temperatures (fig. 7B) were quite high under the upper level ridge with days of 100°F or more very frequent; near the upper trough, temperatures were 3°–6°F below normal from the Ohio Valley to the Middle Atlantic States.

Heavy precipitation (fig. 7C) caused local flooding in parts of Iowa, Missouri, Georgia, and North Carolina. The most widespread rain fell in the central Mississippi Valley where a surface front remained stationary during the week. One migratory cold front, accompanied by insignificant precipitation, reached the Great Plains States by Sunday as a short wave moved out of the west coast trough. Hurricane Celia caused 4- to 6-in. rains in southern Texas early in the week and amounts generally less than an inch in the southern Rockies as moisture from the hurricane moved around the upper level ridge.

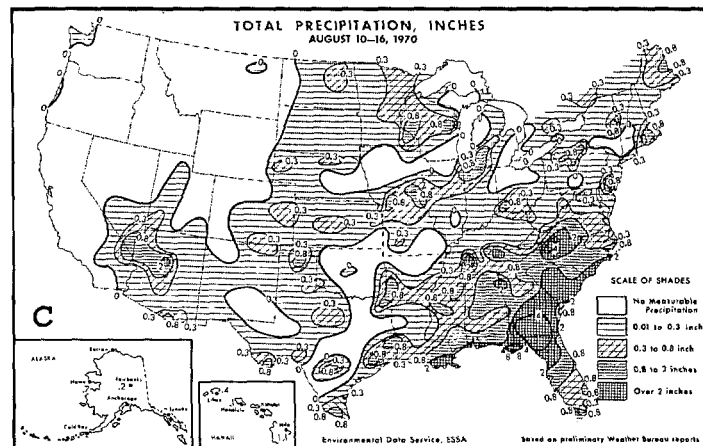
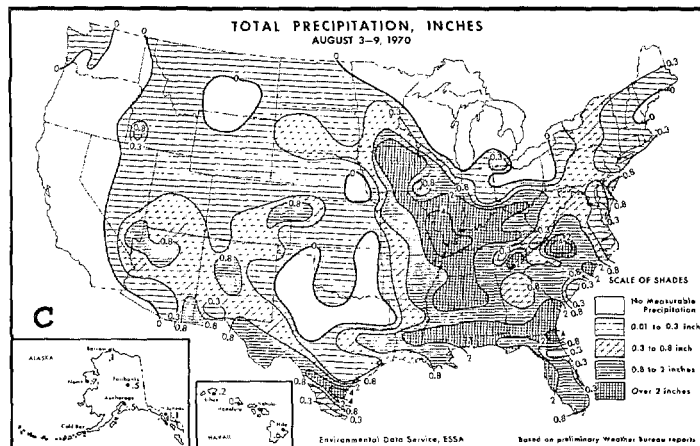
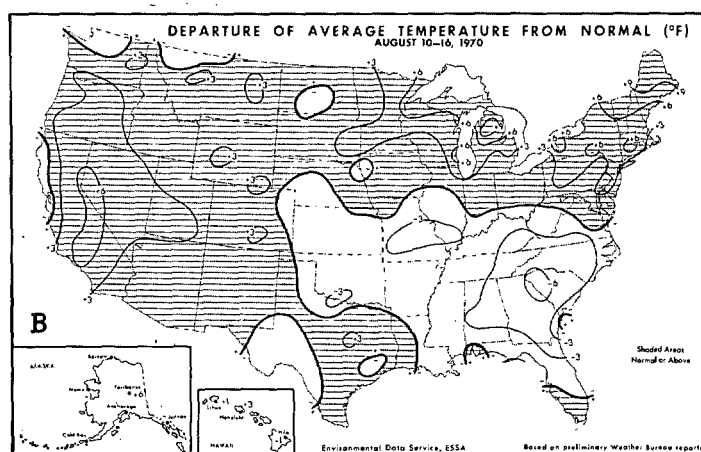
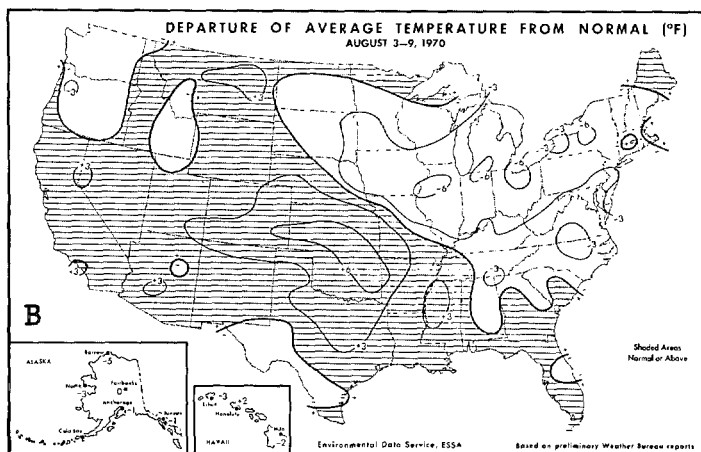
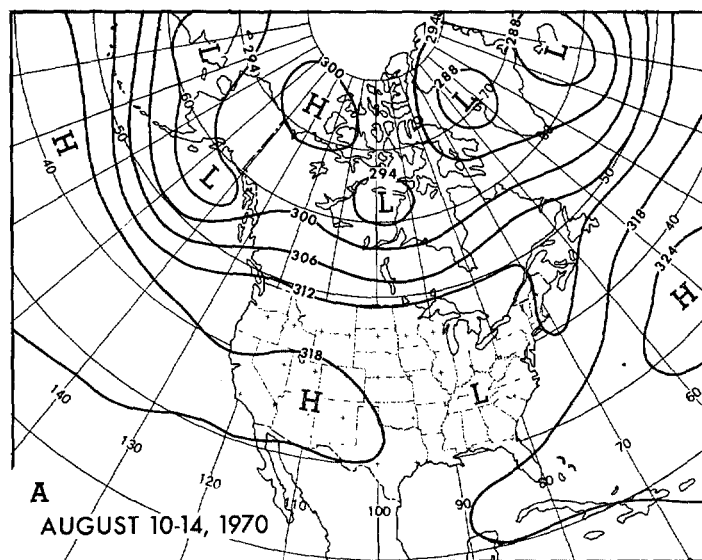
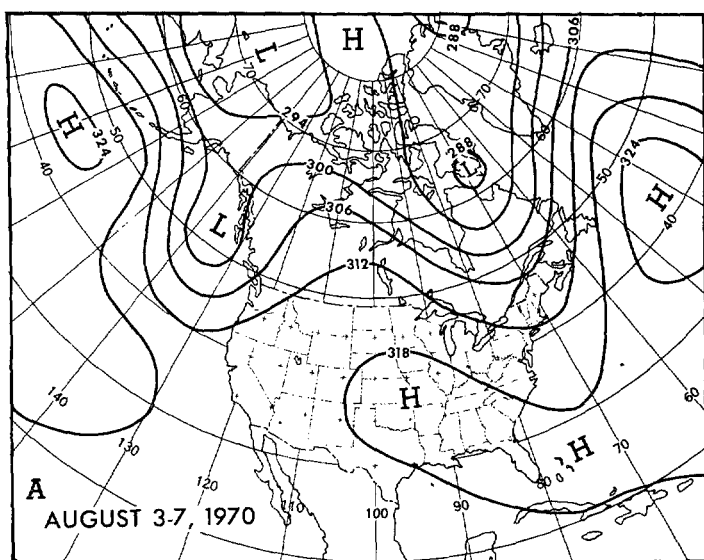


FIGURE 7.—(A) mean 700-mb contours (decameters) for Aug. 3-7, 1970; (B) departure from normal of average surface temperature (°F) and (C) total precipitation (inches) both for Aug. 3-9, 1970 (from Environmental Science Services Administration and Statistical Reporting Service 1970).

FIGURE 8.—Same as figure 7, (A) for Aug. 10-14, 1970; (B) and (C) for Aug. 10-16, 1970 (from Environmental Science Services Administration and Statistical Reporting Service 1970).

SECOND WEEK

The circulation changed rapidly this week (fig. 8A) as a portion of the trough formerly in the eastern Pacific moved into central Canada and replaced the ridge of last week. The increased westerly flow caused the trough in eastern North America to be sheared and replaced in

eastern Canada with a ridge. This created a blocking pattern with a 90-m positive height anomaly (not shown) over southeastern Quebec and a 50-m negative height anomaly center in the central Appalachians.

Average weekly temperatures (fig. 8B) reacted typically to the blocking. Warmer than normal temperatures related to the flat 700-mb flow still covered most of the western half of the Nation. Bakersfield, Calif., averaged

8°F above normal with 104°F as its lowest maximum this week. At Daggett, Calif., the maximum reached 113°F. Midsummer heat spread through the Great Lakes to New England, and temperatures generally averaged 4°–10°F above normal. Concord, N.H., had a daily maximum of 96°F. Below-normal temperatures in the Southeast resulted from cloudiness and precipitation associated with the slow-moving front and surface cyclonic systems.

Heavy precipitation (fig. 8C) shifted eastward from the central Plains States to the Southeastern States as an upper level Low developed over Tennessee. Two to 4 in. of rain fell from northern Florida to western North Carolina. Excessive amounts were reported at Apalachicola, Fla. (11.50 in., about 10 in. over normal) and at Mortimer, N.C. (11.10 in. in 48 hr). Over the rest of the country, amounts were generally less than an inch except at Flagstaff, Ariz., where 2.1 in. was reported.

THIRD WEEK

Ridging this week in western Canada resulted when the Low in the Gulf of Alaska and the trough associated with it reappeared about 15° farther west (fig. 9A). In response to this ridging, cyclonic vorticity was ejected from the Gulf of Alaska trough and driven into central Canada and the northern Great Lakes to form a complicated flow pattern that was cyclonic, yet remnants of blocking remained in the Maritime Provinces and New England.

Temperatures averaged a few degrees above normal over most of the Nation (fig. 9B) except in the Great Lakes and parts of the central Plains States and the Southeast. In these areas, temperatures were 1°–4°F below normal. In parts of the Plains States and in the Southwest, daily temperatures commonly reached 100°F or more. Russell, Kans., reported 108°F. Temperatures that were 1°–4°F below normal spread along the Pacific coast from northern California to Washington. East of the Rockies, temporary cooling began on Wednesday as a migratory High from southern Alberta moved south-eastward across the lakes and off the east coast by the end of the week. Freezing temperatures were reported in western Wyoming, shown by the dotted line in figure 9B.

Many areas in the eastern half of the Nation received 2–4 in. and more of rain this week (fig. 9C). Most of it was associated with the passage of two frontal systems, one in the middle of the week and the other by the weekend.

FOURTH WEEK

The Gulf of Alaska trough weakened this week (fig. 10A), and the ridge over North America maintained its strength in the north while it intensified over the central Rockies and southern Plains States. A trough became established in the eastern United States associated with a deep center of action near Newfoundland with a secondary Low in Mississippi.

Temperatures increased 5°–10°F this week from Nebraska to Pennsylvania as hot weather covered two-thirds of the Nation (fig. 10B). Positive temperature anomaly reached 8°F at Pueblo, Colo., under the mean upper level

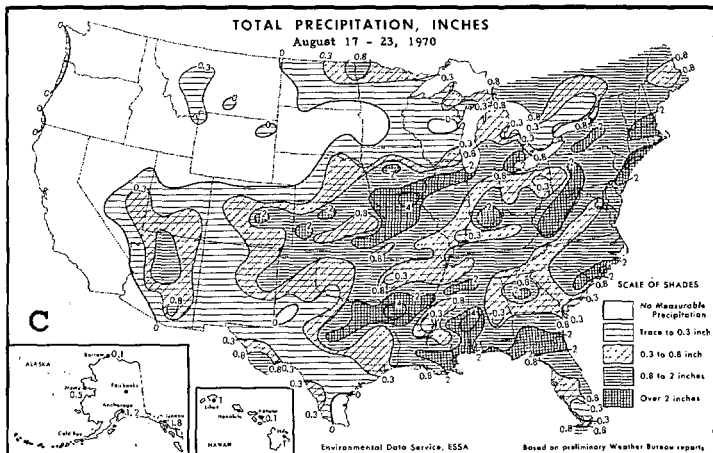
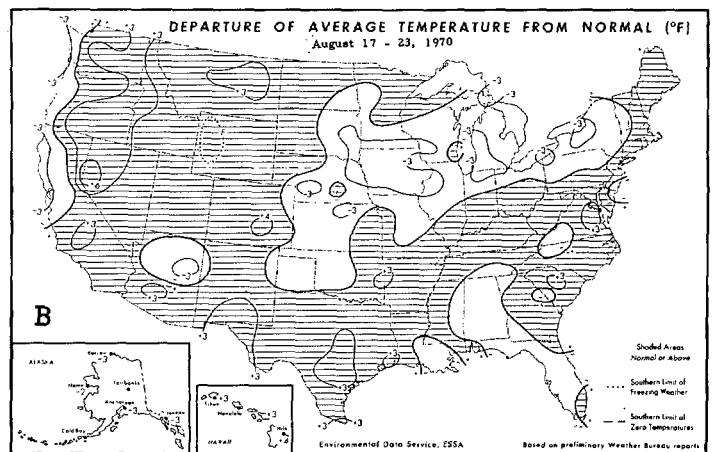
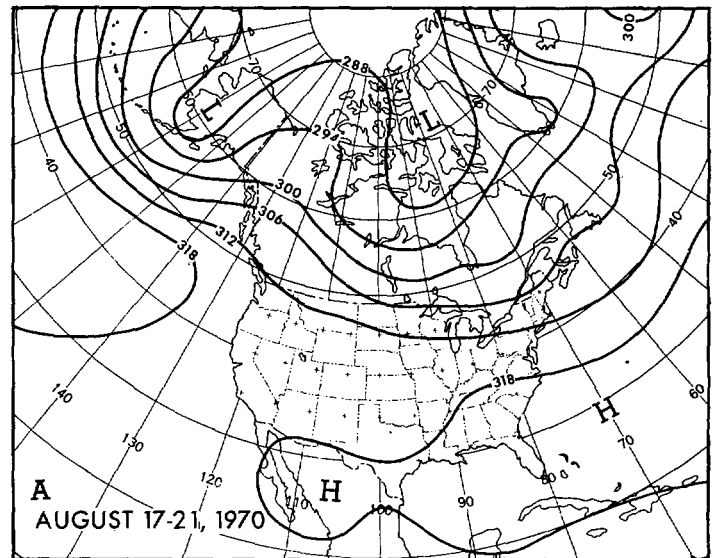


FIGURE 9.—Same as figure 7, (A) for Aug. 17–21, 1970; (B) and (C) for Aug. 17–23, 1970 (from Environmental Science Services Administration and Statistical Reporting Service 1970).

High. Temperatures were below normal over most of the South and Southeast with the coolest air relative to normal at Wichita Falls, Tex. (–7°F). Other areas with temperatures slightly less than normal included northern California and parts of the Northeast.

Precipitation that was associated with a storm track in the north resulted generally in less than an inch from the Dakotas to New England (fig. 10C). In the Southern

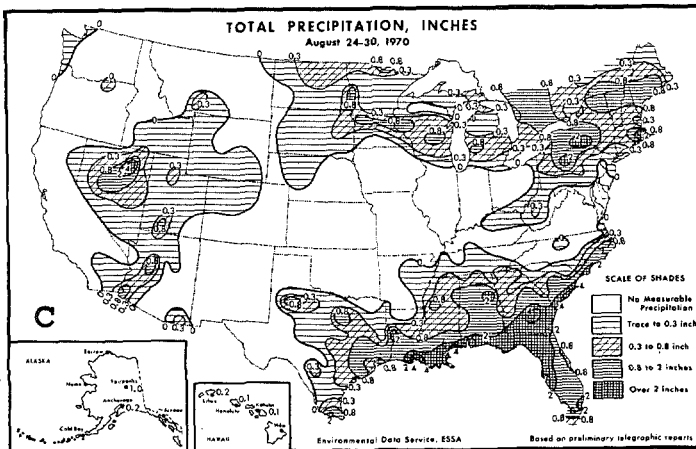
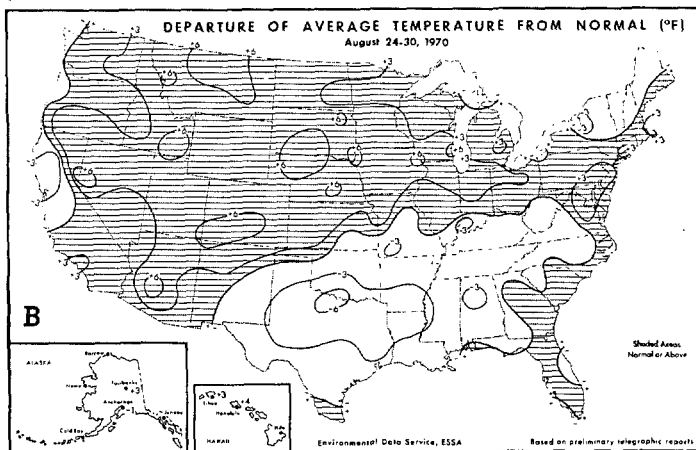
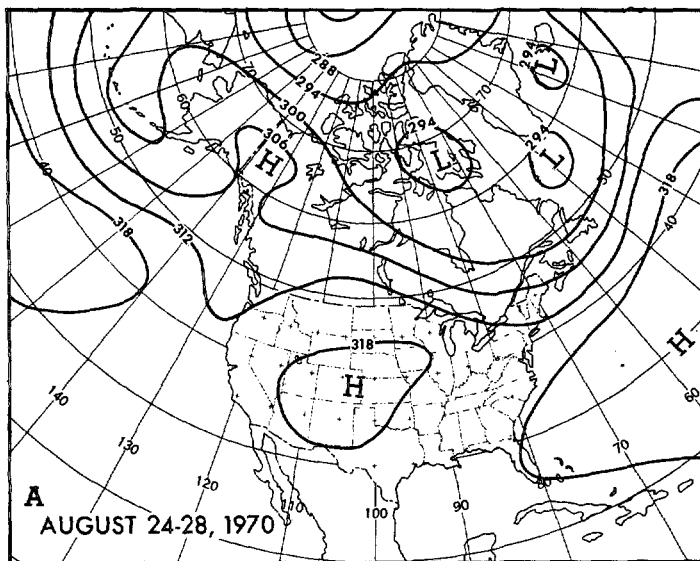


FIGURE 10.—Same as figure 7, (A) for Aug. 24-28, 1970; (B) and (C) for Aug. 24-30, 1970 (from Environmental Science Services Administration and Statistical Reporting Service 1970).

States, 2 to 4 in. and more fell along the Atlantic and gulf coasts from Louisiana to South Carolina as a front lay in that area for 4 days. Charleston, S.C., reported 6.4 in. this week, more than 5 in. above normal.

5. TROPICAL ACTIVITY

Hurricane Celia struck the Texas coast near Corpus Christi on August 3 with exceptionally strong winds for so small a storm that became a hurricane less than 2 days earlier. The highest sustained wind averaged 130 mi hr^{-1} at Corpus Christi Airport with a maximum gust of 161 mi hr^{-1} . The greatest precipitation totaled 6.50 in. at Aransas Pass with lesser amounts inland as far as El Paso (up to 2 in. in suburbs) 2 days later. Five-day mean 700-mb flow at this time (fig. 7A) showed a ridge from the Bahamas to the central Plains States and a trough off the east coast. This type of flow favors tracks of tropical disturbances in the Gulf of Mexico with a stronger westerly component then northerly, provided the pattern remains stable. Daily 500-mb charts during this period showed a ridge from the South Atlantic States to the central Plains States with heights above normal each day.

Wilmington, N.C., and nearby portions of the coastal plain received 3- to 5-in. rains, associated with a weak tropical depression that passed 35 mi east of Wilmington on August 17.

Tropical storm Dorothy formed on August 19 about 200 mi east of Martinique. Several deaths were reported as the storm passed over the island. The storm continued west-northwestward and dissipated 100 mi south of Haiti on August 22.

Remnants of tropical storm Maggie on August 25 and 26 caused very heavy rainfall in windward areas of the island of Hawaii, the southernmost island of the chain. At Hilo, 11.48 in. fell on these 2 days. Nearby areas received 10 to more than 15 in.

Puerto Rico reported heavy rainfall of 4-7 in. over a large area in the eastern half of the island as a strong tropical wave passed on August 27 and 28. This caused local flooding but only minor damage. Average island rainfall was about 4 in. above normal. Maximum total was 8.83 in. at Aibonito in the mountains south of San Juan.

REFERENCES

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- Orton, Robert B., "Preliminary Report: Hurricane Celia July 31-August 5, 1970," *Weekly Weather and Crop Bulletin*, Environmental Data Service, ESSA, U.S. Department of Commerce, and Statistical Reporting Service, U.S. Department of Agriculture, Vol. 57, No. 32, Aug. 10, 1970, pp. 12-13.